

1        1. A process for creating a barrier layer on a semiconductor substrate  
2 comprising:

3                  forming a discrete region in the semiconductor substrate;

4                  exposing the surface of the discrete region to a metal-containing source gas  
5 and to ozone gas to react the source gas with the ozone gas to form from the reaction  
6 a barrier layer of metal oxide film on the surface of the discrete region.

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8        2. A process as recited in claim 1, wherein the source gas and the ozone gas are  
9 reacted in the CVD process at a pressure of about 0.1 torr to about <sup>1</sup>/torr.

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11        3. A process as recited in claim 1, wherein the source gas comprises an  
12 organometallic compound.

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14        4. A process as recited in claim 1, wherein the metal oxide film of the barrier  
15 layer is selected from a group consisting of a conductive metal oxide file, Ru oxide film, and  
16 aluminum oxide film.

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18        5. A process as recited in claim 3, wherein the ozone gas volatilizes and frees  
19 into the atmosphere substantially all of the carbon contained in the source gas.

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21        6. A process as recited in claim 1, wherein forming the discrete region is  
22 followed by covering the discrete region with a oxide layer and etching a contact opening  
23 through the oxide layer to contact the discrete region, and wherein the surface of the contact  
24 opening is covered with the barrier layer.

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1        7. A process as recited in claim 6, wherein exposing the surface of the discrete  
2 region to a metal-containing source gas and ozone is followed metallizing the contact  
3 opening with a metallization material, wherein the barrier layer functions as a diffusion  
4 barrier to substantially preventing the metallization material from contacting the discrete  
5 region.

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7        8. A process as recited in claim 1, wherein the discrete region is covered with  
8 a second structural layer, with the discrete region and the second structural layer being  
9 separate from the oxide layer, the process further comprising etching a via opening through  
10 the oxide layer above the discrete region to electrically connect the discrete region and the  
11 second structural layer, and wherein the via opening is covered with the barrier layer.

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13        9. A process as recited in claim 1, further comprising:  
14              forming a oxide layer over the barrier layer; and  
15              etching an opening in the oxide layer with an etchant, wherein the barrier  
16 layer functions as an etch stop to substantially prevent the etchant from contacting  
17 the discrete region.

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19        10. A process as recited in claim 1, wherein exposing the surface of the discrete  
20 region is accomplished by disposing the semiconductor substrate in a CVD reaction chamber  
21 and introducing a feed stream containing an inert carrier, the metal containing source gas  
22 comprising a metal organic source gas, and the ozone gas into the reaction chamber.

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24        11. A process as recited in claim 10, wherein the source gas is selected from the  
25 group consisting of aluminum trimethane, titanium tetramethane, tantalum, trimethyl  
26 aluminum hydrate, a Ru metalorganic precursor, and dimethyl aluminum hydrate.

1           12. A process as recited in claim 10, wherein the barrier layer is selected from  
2 a group consisting of a conductive metal oxide film, Ru oxide film, and aluminum oxide film.

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4           13. A process as recited in claim 7, wherein the diffusion barrier is in electrical  
5 communication with the discrete region.

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7           14. A process for creating a barrier layer on a semiconductor substrate  
8 comprising:

9                 forming a discrete region in the semiconductor substrate;  
10                exposing the surface of the discrete region to ozone gas and to a source gas  
11                selected from the group consisting of aluminum trimethane, titanium tetramethane,  
12                tantalum, trimethyl aluminum hydrate, a Ru metalorganic precursor, and dimethyl  
13                aluminum hydrate to react the source gas with the ozone gas and deposit from said  
14                reaction a barrier layer of metal oxide film on the surface of the discrete region.

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1           15. A process for creating a barrier layer on a semiconductor substrate  
2 comprising:

3                 forming a discrete region in the semiconductor substrate;

4                 covering the discrete region with ~~an~~ oxide layer;

5                 etching a contact opening through the oxide layer to contact the discrete  
6 region;

7                 exposing the surface of the discrete region to a metal-containing source gas  
8 and to ozone gas to react the source gas with the ozone gas to deposit a barrier layer  
9 of metal oxide film on the surface of the discrete region, wherein the surface of the  
10 contact opening is covered with the barrier layer;

11                 forming a structural layer over the barrier layer, said structural layer being  
12 prevented by the barrier layer from reacting with the discrete region;

13                 metalizing the contact opening with a metallization material, wherein the  
14 barrier layer functions as a diffusion barrier to substantially preventing the  
15 metallization material from contacting the discrete region and wherein the diffusion  
16 barrier covers the discrete region.

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1           16. A process for creating a barrier layer on a semiconductor substrate  
2 comprising:

3                 forming a discrete region in the semiconductor substrate;  
4                 exposing the surface of the discrete region to a metal-containing source gas  
5                 and to ozone gas to react the source gas with the ozone gas to deposit a barrier layer  
6                 composed of aluminum oxide on the surface of the discrete region;  
7                 forming a oxide layer over the barrier layer;  
8                 etching an opening in the oxide layer with a first etchant, wherein the barrier  
9                 layer functions as an etch stop to substantially prevent the etchant from contacting  
10               the discrete region;  
11                 removing the barrier layer with a solution of phosphoric acid.

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1        17. A process for creating a barrier layer on a semiconductor substrate  
2 comprising:

3              forming a discrete region in the semiconductor substrate;  
4              disposing the semiconductor substrate in a reaction chamber;  
5              heating the silicon substrate to within a range of 100 ° C to about 1000 ° C;  
6              introducing an inert carrier gas into the reaction chamber;  
7              introducing a vaporized organometallic source gas and ozone gas into the  
8              reaction chamber, the organometallic source gas being a compound comprising  
9              metal, carbon, and hydrogen;  
10             introducing ozone gas into the reaction chamber to react the source gas with  
11             the ozone gas and to deposit from said reaction a metal oxide film on at least a  
12             portion of the surface of the discrete region as a barrier layer.

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14        18. The process as defined in Claim 17, further comprising:

15             halting the introduction of the source gas and ozone gas to the reaction  
16             chamber;  
17             purging the reaction chamber; and  
18             removing the semiconductor substrate from the reaction chamber.

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20        19. A process as recited in claim 17, wherein the barrier layer functions as a  
21             diffusion barrier and is formed on the surface of an opening in a oxide layer that has been  
22             formed over the underlying discrete region.

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24        20. A process as recited in claim 17, wherein the barrier layer functions as a  
25             diffusion barrier and prevents interdiffusion of the discrete region with a later deposited  
26             structure.

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1        21. A process as recited in claim 17, wherein the reaction chamber is pressurized  
2        within a range of about 0.1 to about 1 torr.

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4        22. A process as recited in claim 17, wherein the barrier layer is electrically  
5        conductive.

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7        23. A process for creating a barrier layer on a semiconductor substrate  
8        comprising:

9              forming a discrete region in the semiconductor substrate;

10             disposing the semiconductor substrate in a reaction chamber;

11             heating the silicon substrate to within a range of 100 °C to about 1000 °C;

12             introducing an inert carrier gas into the reaction chamber;

13             introducing a vaporized organometallic source gas and ozone gas into the  
14             reaction chamber, the organometallic source gas being a compound comprising  
15             metal, carbon, and hydrogen;

16             introducing ozone gas into the reaction chamber to react the source gas with  
17             the ozone gas and to deposit from said reaction a metal oxide etch stop film on at  
18             least a portion of the surface of the discrete region;

19             forming an oxide layer over the metal oxide etch stop film;

20             etching an opening within an etchant in the oxide layer, where the metal  
21             oxide etch stop film substantially prevents the etchant from etching the discrete  
22             region.

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24        24. A process as recited in claim 23, wherein the metal oxide etch stop film is  
25        selected from a group consisting of a conductive metal oxide file, Ru oxide film, and  
26        aluminum oxide film.

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1        25. A process as recited in claim 23, wherein the source gas is selected from the  
2 group consisting of aluminum trimethane, titanium tetramethane, tantalum, trimethyl  
3 aluminum hydrate, a Ru metalorganic precursor, and dimethyl aluminum hydrate.

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